PATENT COOPERATION TREA

Re PCT OCT 2004

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION See Form PCT/IPEA/416	
E29161 JFW/JOB		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NO 2003/000107	02.04.2003	02-04-2002
International Patent Classification (IPC) or national classification and IPC		
B23K 9/095 // G05D 7/06		
Applicant		
WelTec AS et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:

   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 8 sheets, as follows:

      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).

      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.

   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))

      _____, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
24-10-2003	14-04-2004
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer Magnus Westöö/MN Telephone No. +46 8 782 25 00

Form PCT/IPEA/409 (cover sheet) (January 2004)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/NO 2003/000107

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of:

☐ international search (under Rules 12.3 and 23.1(b))
☐ publication of the international application (under Rule 12.4)
☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

☐ the international application as originally filed/furnished

☒ the description:

pages 1-14 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____

☒ the claims:

pages _____ as originally filed/furnished
pages* _____ as amended (together with any statement) under Article 19
pages* 15-22 received by this Authority on 05-04-2004
pages* _____ received by this Authority on _____

☒ the drawings:

pages 1/7-7/7 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/figs _____
☐ the sequence listing *(specify)*: _____
☐ any table(s) related to the sequence listing *(specify)*: _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/figs _____
☐ the sequence listing *(specify)*: _____
☐ any table(s) related to the sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

ational application No.
PCT/NO 2003/000107

Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-25	YES
	Claims		NO
Inventive step (IS)	Claims	1-25	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-25	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

Cited document D: DE 3827383 A1

The invention relates to a control system and a method for controlling the shielding gas supply of an automatic welding apparatus. The invention also relates to the welding apparatus comprising the control system.

Of the documents cited in the International Search Report, document D is regarded as the most relevant one.

Document D discloses a control system for controlling the shielding gas supply to a wire welding apparatus having a wire feed device 15 having a feed signal output (col. 3, lines 19-21). Moreover, document D discloses a controllable gas flow valve 18 having a control signal input (col. 3, lines 16-19). The feed signal as well as a signal representing the actual gas flow are delivered to the inputs of a control circuit 22, 23. An output of the control circuit provides a control signal to the controllable gas flow valve. In the amended claims, the independent claims 1, 2, 14, 15, 16, 17 define characteristics of this control signal, which characteristics are not disclosed by document D. There are no indications in document D that would lead a person skilled in the art to the claimed control system or method. The remaining independent claim is merely an apparatus comprising the control system as defined in some of the preceding claims. The claimed invention is not obvious to a person skilled in the art.

Accordingly, the invention defined in claims 1-25 is novel and is considered to involve an inventive step. The invention is industrially applicable.

Patent claims

1.

A control system for controlling the shielding gas supply of an automatic welding apparatus, which automatic welding apparatus has a continuous electrode feed device (106) having a feed signal output which is indicative of a continuous electrode feeding speed (U), which automatic welding apparatus is connected to a gas tank (101) via a gas supply line (201, 202), in which supply line there may according to choice be arranged a pressure regulator (102) and a manometer (103),
characterised in that the control system comprises
a controllable gas flow valve (110) having a valve gas inlet, a valve gas outlet and a valve control signal input for receiving a valve control signal;
a gas flow sensor (111) having a gas inlet, a gas outlet and a sensor signal output; and
a programmable control circuit (112) having a first and a second input and a first output;
wherein the gas tank has an inlet connection (201, 202) to the valve gas inlet, the valve gas outlet has a valve outlet connection (207) to the gas inlet, the gas outlet has a gas outlet connection (208) to a shielding gas outlet, the feed signal output has a feed signal connection (203) to the first input, the sensor signal output has a sensor signal connection (205) to the second input, the first output has a control signal connection (206) to the valve control signal input,
the programmable control circuit comprises a processor which, in accordance with at least one program in a first memory in the control circuit, and on the basis of signals received at the first and second inputs, provides at the first output the valve control signal, which provided valve control signal is adjustable by means of the programmable control circuit within a dynamic range of values limited in accordance with a predetermined minimum gas flow (Qmin) through the valve and a predetermined maximum gas flow (Qmax) through the valve, and
the program comprises at least one instruction to the processor instructing the processor to issue at the first output a signal that is constant and having a value which corresponds substantially to the minimum gas flow (Qmin) through the valve from the time the signal at the first input exceeds a first threshold value (Uth1) and in an immediately subsequent first predetermined time period.

2.

A control system for controlling the shielding gas supply of an automatic welding apparatus, which automatic welding apparatus has a continuous electrode feed device

(106) having a feed signal output which is indicative of a continuous electrode feeding speed (U), which automatic welding apparatus is connected to a gas tank (101) via a gas supply line (201, 202), in which supply line there may according to choice be arranged a pressure regulator (102) and a manometer (103),

characterised in that the control system comprises

a controllable gas flow valve (110) having a valve gas inlet, a valve gas outlet and a valve control signal input for receiving a valve control signal;

a gas flow sensor (111) having a gas inlet, a gas outlet and a sensor signal output; and

a programmable control circuit (112) having a first and a second input and a first output;

wherein the gas tank has an inlet connection (201, 202) to the valve gas inlet, the valve gas outlet has a valve outlet connection (207) to the gas inlet, the gas outlet has a gas outlet connection (208) to a shielding gas outlet, the feed signal output has a feed signal connection (203) to the first input, the sensor signal output has a sensor signal connection (205) to the second input, the first output has a control signal connection (206) to the valve control signal input,

the programmable control circuit comprises a processor which, in accordance with at least one program in a first memory in the control circuit, and on the basis of signals received at the first and second inputs, provides at the first output the valve control signal, which provided valve control signal is adjustable by means of the programmable control circuit within a dynamic range of values limited in accordance with a predetermined minimum gas flow (Qmin) through the valve and a predetermined maximum gas flow (Qmax) through the valve, and

the control circuit comprises a second memory arranged to continuously register the signal value at the first output of the control circuit; and

that the program comprises at least one instruction to the processor instructing the processor issue at the first output from the time the signal at the first input falls short of a second threshold value (Uth2) and in an immediately subsequent second predetermined time period signal that us constant and having a value that substantially corresponds to the signal value at the time, or immediately prior to the time, when the signal at the first input fell short of the second threshold value.

3.

A control system as disclosed in claim 1 or 2,

characterised in that the programmable control circuit has a third input, which third input is a communications port for the transfer of the at least one program from a programming device (113), via a communication connection (204), to the memory.

4.

A control system as disclosed in claim 1, 2 or 3,
characterised in that the program comprises at least one instruction to the processor instructing the processor to issue the valve control signal as a signal that is proportional to a signal representing the difference between the signal at the first input and the signal at the second input.

5.

A control system as disclosed in claim 1 or 2,
characterised in that the program comprises at least one instruction to the processor instructing the processor to issue the valve control signal as a signal that is proportional to a signal representing the difference between the signal at the first input and the signal at the second input, proportional to a signal representing a time integral of the difference between the signal at the first input and the signal at the second input, and proportional to a signal representing a time derivative of the difference between the signal at the first input and the signal at the second input.

6.

A control system as disclosed in claims 2 and 3,
characterised in that the first threshold value (Uth1) is equal to the second threshold value (Uth2).

7.

A control system as disclosed in claims 2 and 3 or claim 6,
characterised in that the control circuit comprises a control parameter register for storing at least one of the minimum gas flow (Qmin) through the valve, the maximum gas flow (Qmax) through the valve, the first threshold value (Uth1), the second threshold value (Uth2), a continuous electrode feeding speed minimum threshold (Umin) and a continuous electrode feeding speed maximum threshold (Umax),
that the program comprises at least one instruction to the processor instructing the processor to set a proportionality so that the control circuit at the first output issues the valve control signal in accordance with minimum value (Qmin) when the feeding speed (U) corresponds to the feeding speed minimum threshold (Umin) and in accordance with the maximum value (Qmax) when the feeding speed (U) corresponds to the feeding speed maximum threshold (Umax); and
that the program comprises at least one instruction to the processor instructing the processor to issue at the first output the valve control signal in accordance with the

minimum gas flow (Qmin) through the valve when the continuous electrode feeding speed (U) is below the feeding speed minimum threshold (Umin) and the valve control signal in accordance with the maximum gas flow (Qmax) through the valve when the feeding speed (U) is above the feeding speed maximum threshold (Umax).

8.

A control system as disclosed in any one of the preceding claims, characterised in that the programmable control circuit has a second output, which second output issues a warning signal when the first output issues the valve control signal in accordance with the minimum gas flow (Qmin) through the valve or when the feeding speed (U) is equal to or lower than the feeding speed minimum threshold (Umin).

9.

A control system as disclosed in any one of the preceding claims, characterised in that the programmable control circuit has a second output, which second output issues a warning signal when the first output issues the valve control signal in accordance with the maximum gas flow (Qmax) through the valve or when the feeding speed (U) is equal to or higher than the feeding speed maximum threshold (Umax).

10.

A control system as disclosed in claim 3, characterised in that the communications port is also arranged for the transfer of control parameters from the programming device (113), via the communication connection (204), to the programmable control circuit.

11.

A control system as disclosed in any one of claims 3 and 10, characterised in that the communications port is also arranged for the transfer between the programming device and the programmable control circuit of data stored in, or for storage in, the parameter register and of data representing at least one of a valve control signal, a feeding speed (U), and a warning signal.

12.

A control system as disclosed in any one of claims 3, 10 and 11,

characterised in that the programming device comprises a user interface for the input of control parameters and for the display of data transferred to and from the programmable control circuit.

13.
A control system as disclosed in any one of claims 3, 10, 11 and 12, characterised in that the programming device is a personal computer (PC).

14.
A method for controlling a shielding gas supply in an automatic welding apparatus by means of a control system as claimed in any one of claims 1to 13, the method characterised by
outputting the valve control signal at the first output in the form of a signal that is proportional to a signal representing a difference between the signal at the first input and the signal at the second input, and outputting at the first output the valve control signal as a signal that is constant and having a value which corresponds substantially to the minimum gas flow (Qmin) through the valve from the time the signal at the first input exceeds a first threshold value (Uth1) and in an immediately subsequent first predetermined time period.

15.
A method for controlling a shielding gas supply in an automatic welding apparatus by means of a control system as claimed in any one of claims 1 to 13, the method characterised by
outputting the valve control signal at the first output in the form of a signal that is proportional to a signal representing the difference between the signal at the first input and the signal at the second input, and
outputting at the first output, from the time that the signal at the first input fall short of a second threshold value (Uth2) and in an immediately subsequent second predetermined time period, the valve control signal as a signal that is constant and having a value that substantially corresponds to the signal value at the time, or immediately prior to the time, when the signal at the first input fell short of the second threshold value.

16.
A method for controlling a shielding gas supply in an automatic welding apparatus by means of a control system as claimed in any one of claims 1 to 13, the method characterised by

outputting the valve control signal at the first output in the form of a signal that is proportional to a signal representing the difference between the signal at the first input and the signal at the second input, proportional to a signal representing a time integral of the difference between the signal at the first input and the signal at the second input, and proportional to a signal representing a time derivative of the difference between the signal at the first input and the signal at the second input, and

outputting at the first output the valve control signal as a signal that is constant and having a value which corresponds substantially to the minimum gas flow (Qmin) through the valve from the time that the signal at the first input exceeds a first threshold value (Uth1) and in an immediately subsequent first predetermined time period.

17.

A method for controlling a shielding gas supply in an automatic welding apparatus by means of a control system as claimed in any one of claims 1 to 13, the method characterised by

outputting the valve control signal at the first output in the form of a signal that is proportional to a signal representing the difference between the signal et the first input and the signal at the second input, proportional to a signal representing a time integral of the difference between the signal at the first input and the signal at the second input, and proportional to a signal representing a time derivative of the difference between the signal at the first input and the signal at the second input, and

outputting at the first output, from the time that the signal at the first input falls short of a second threshold value (Uth2) and in a immediately subsequent second predetermined time period, the valve control signal as a signal that is constant and having a value that substantially corresponds to the signal value at the time, or immediately prior to the time, when the signal at the first input fell short of the second threshold value.

18.

A method as disclosed in claims 14 and 15, or 16 and 17, characterised in that the first threshold value (Uth1) is equal to the second threshold value (Uth2).

19.

A method as disclosed in claims 14 and 15, 16 and 17, or 18, characterised by storing in a control parameter register in the control circuit at least one of the minimum gas flow (Qmin) through the valve, the maximum gas flow (Qmax) through the valve, the first threshold value (Uth1), the second threshold value (Uth2), a continuous electrode

feeding speed minimum threshold (Umin) and a continuous electrode feeding speed maximum threshold (Umax);

setting a proportionality so that the control circuit at the first output issues the valve control signal in accordance with minimum gas flow (Qmin) through the valve when the continuous electrode feeding speed (U) corresponds to the wire feeding speed minimum threshold (Umin) and the maximum gas flow (Qmax) through the valve when the wire feeding speed (U) corresponds to the wire feeding speed maximum threshold (Umax); and

by issuing at the first output the valve control signal in accordance with the minimum gas flow (Qmin) through the valve when the wire feeding speed (U) is below the feeding speed minimum threshold (Umin) and the maximum gas flow (Qmax) through the valve when the feeding speed (U) is above the feeding speed maximum threshold (Umax).

20.

A method as disclosed in one of claims 15, 16, 17, 18 and 19, characterised by issuing at a second output of the programmable control circuit a warning signal when the first output issues the valve control signal in accordance with the minimum gas flow (Qmin) through the valve or when the feeding speed (U) is equal to or lower than the feeding speed minimum threshold (Umin), or a warning signal when the first output issues the valve control signal in accordance with the maximum gas flow (Qmax) through the valve or when the feeding speed (U) is equal to or higher than the wire feeding speed maximum threshold (Umax).

21.

A method as disclosed in one of claims 15 - 20, characterised by transferring control parameters, from a programming device (113), via a communication connection (204), to the programmable control circuit.

22.

A method as disclosed in one of claims 15-21, characterised by transferring between a programming device (113) and the programmable control circuit, via a communication connection (204), data stored, or for storage in the parameter register, and data representing at least one of a valve control signal, a feeding speed (U), and a warning signal.

23.
A method as disclosed in claim 22, characterised by entering control parameters and by displaying data transferred to and from the programmable control circuit, by means of a user interface in the programming device.

24.
A method as disclosed in one of claims 22 - 23, characterised in that the programming device is a personal computer (PC).

25.
A welding apparatus, characterised in that it comprises the control system according to any one of patent claims 1-13.